

Lake Delhi Dam Reconstruction Design Alternatives Report

Lake Delhi Combined Recreational Facility
and Water Quality District

Transportation, Infrastructure, and Capitals
Appropriations Subcommittee Presentation

February 2, 2012

Alternatives Report Presentation Agenda:

- I. Introduction
- II. Project Objectives
- III. Facility Description
- IV. Field Investigation and Data Collection
- V. Engineering Analysis
- VI. Hazard Classification
- VII. Repair Alternatives Development and Evaluation
- VIII. Recommended Project
- IX. Construction Schedule/Phasing
- X. Construction Cost Estimate
- XI. Moving Forward
- XII. Questions

I. Introduction

Project Team

- Stanley Consultants
- Gibbs Engineering and Surveying
- Braun INTERTEC
- Louis Berger Group
- Lake Delhi Combined Recreational Facility and Water Quality District

II. Project Objectives

- Document Condition of Lake Delhi Dam
- Collect Data to Perform Technical Analysis and Design of Dam Repairs
- Review Regulatory Requirements
- Complete Archaeological Reconnaissance
- Develop and Evaluate Alternatives for Repairing Lake Delhi Dam
- Provide “Recommended Project”, Bringing Dam Into Compliance with Current Dam Safety Standards.
- Provide Estimate of Construction Costs and Schedule.

III. Description of Existing Facility Features

- Pool Area
- North Embankment
- North Abutment Wall
- Powerhouse
- Gated Spillway
- Stilling Basin
- South Buttress Wall
- South Embankment



IV. Field Investigation and Data Collection

- Document Review
- Topographic Survey
- Property Research
- Geotechnical Investigations
- Structural Investigations
- Electrical Investigations
- Mechanical Investigations
- Archeological Reconnaissance
- Permitting Requirements Review

Document Review

- Original Design Drawings
- Repair Drawings/Specifications
- 1997 Ashton-Barnes Inspection, Stability, and Spillway Adequacy Report
- 2002 J.F. Brennan Co. Underwater Inspection Report and Videos
- 2004 DNR Inspection Report
- 2008 J.F. Brennan Co. Underwater Inspection Report and Videos
- 2009 DNR Inspection Report
- 2010 Stanley Consultants Inspection Report

Topographic Survey & Property Research

- Topographic Survey
 - Complete survey of Project Area – Gibbs
 - Supplement With Light Detection and Ranging (LiDar)
- Property Research – Gibbs
 - Review Gibb's Previous Surveys
 - Review Gibb's Previous Computer Drawings
 - Generate Property Line Exhibit Compiling Previous Work
 - Conduct Research at County Courthouse
 - Add In Geometry of Missing Plats
 - Obtained Coordinates of accessible property pins
 - Compare Surveyed Property Pins to Property line exhibit and adjust
- Future Property Work

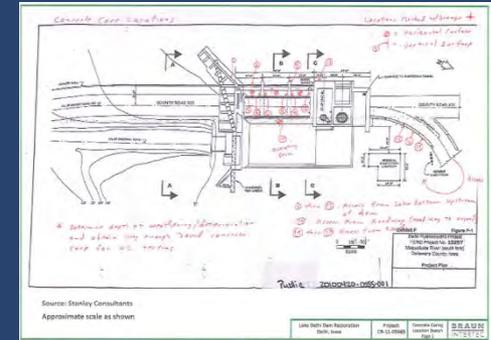
Geotechnical Investigations

- Field Investigations
 - Dam Site
 - Potential Borrow Evaluation
 - Laboratory Testing
- Geotechnical Parameter Development



Structural Investigations

- Initial Field Investigations
 - Concrete Condition Survey
 - Concrete Cores
- Review 1997 Ashton-Barnes Structural Stability Analyses
- Supplemental Investigations
 - Powerhouse/Spillway Foundation Coring



Electrical Investigations

- Power Distribution
- Trash Rakes and Hydroelectric
- Equipment
- Lift Gates
- Emergency Generator System



Mechanical Investigations

- Lift Gates
- Wicket Gates
- Trash Rake



Archeological Reconnaissance



- Louis Berger Group, Inc. (LBG)
- Reconnaissance Level Survey
- Reconnaissance included Lake Delhi Dam and all Exposed land areas within the former impoundment area
- Records review to identify high potential areas
- Field survey to investigate High potential areas
- Seven New Sites Within Study Area
- Total of 12 archaeological sites reported for the study area
- No burial sites were identified within the study area
- None of 12 sites has been evaluated for National Register
- Additional site investigations recommended at all 12
- Additional reconnaissance survey recommended for selected portions of the study area

Permitting Requirements Review

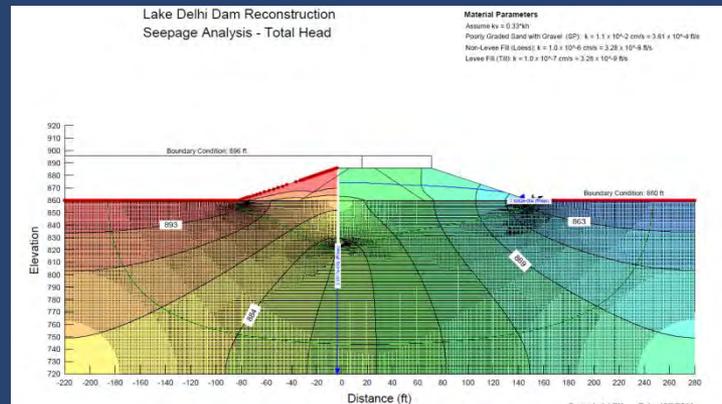
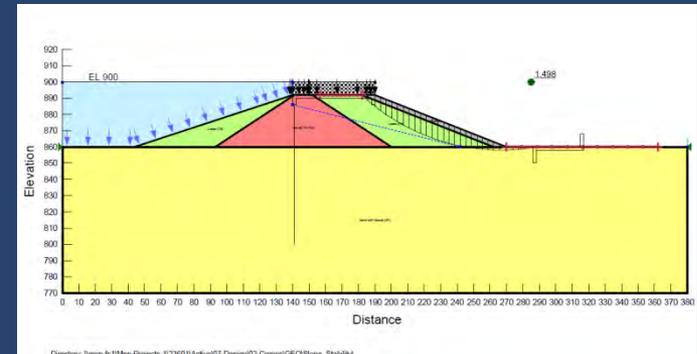
- U.S. Army Corps of Engineers - Section 404 Nationwide Permit (NWP)
- Iowa DNR – Section 401 Water Quality Certification
- Iowa DNR – Sovereign Lands Construction Permit
- Iowa DNR – Floodplain Development Permit
- Cultural Resources
- U. S. Fish and Wildlife Service (FWS)

V. Engineering Analysis

- Geotechnical
- Structural
- Hydrology/Hydraulics
- Hazard Classification

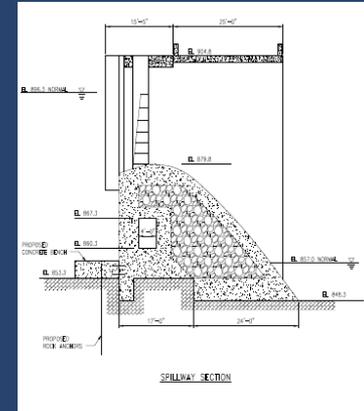
Geotechnical Analyses

- Slope Stability
- Seepage
- Bearing Capacity
- Settlement
- Rock Anchor Capacity
- Erosion/Scour Protection



Structural Analyses

- Structural Stability Analyses
- Preliminary Structure Stabilization Design
- Preliminary Concrete Structure Design
 - Service and Auxiliary Spillways
 - Training/Retaining Walls
 - Concrete Repair



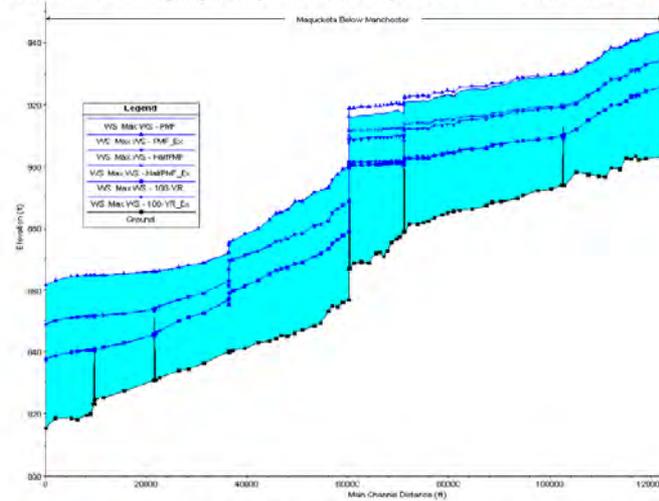
Hydrology/Hydraulics

- Lake Delhi Dam did not have sufficient hydraulic capacity to meet current Iowa dam safety criteria.
- Characterize Maquoketa River Flows at Dam.
- Developing a hydrologic model of Delhi Dam watershed.
- Developing a hydraulic model of Maquoketa River upstream and downstream of Lake Delhi Dam.
- Performing hazard classification and design flood analysis
- Developing Lake Delhi Dam spillway concepts.
- Addressing other hydraulic issues.
 - Minimum Flow
 - Cofferdam By-Pass
 - Lake Draw-Down

Pool Impacts of Dam

Upstream/Downstream Impacts

Hazard classification compares a failure to non-failure condition. Another important comparison is the impact of the reconstructed dam relative to the pre-breach condition. The objective is to provide a reconstructed dam that minimizes negative impacts upstream and downstream. This was analyzed by comparing a series of floods for the pre-breach and reconstructed dam HEC-RAS model.



Without the principal/auxiliary spillway and gate system fully defined this is a preliminary evaluation, so will require updating once the auxiliary spillway and gates are designed for reconstruction.

As can be expected with an increase in hydraulic capacity, the reconstructed dam provides lower peak flood elevations upstream, with minimal increase in flood elevation downstream. So HEC-RAS results indicate that the reconstructed dam will improve upstream flood conditions by

The following table provides flood elevation differences at a series of HEC-RAS cross-sections

Stretch of Maquoketa River	HEC-RAS X-SECT ID	Change in Flood Elev Due w/ New Dam		
		PMF (ft)	1/2 PMF (ft)	100-YR (ft)
Upstream of 197th Ave Bridge	122794	-0.06	-0.03	0
	103398	-0.59	-0.64	-0.04
Between 197th Ave Bridge and Hartwick Bridge	103168	-0.5	-0.65	-0.06
	100907	-0.61	-0.69	-0.08
	94139	-0.71	-0.81	-0.12
	82771	-1.08	-1.23	-0.27
	77805	-1.32	-1.49	-0.43
Between Hartwick Bridge and Lake Delni Dam	71785	-1.61	-1.76	-0.58
	71635	-2.65	-2.73	-0.77
	67720	-2.65	-2.75	-0.79
	63302	-2.83	-2.87	-0.85
Between Lake Delni Dam and Quarter Road Bridge	61003	-2.9	-2.92	-0.87
	60797	0.05	0.06	0.11
	56760	0.04	0.05	0.11
	50035	0.05	0.06	0.11
	45029	0.03	0.06	0.1
Between Quarter Road Bridge and 295th Street Bridge	37165	0.02	0.07	0.1
	36995	0.05	0.05	0.06
	27088	0.06	0.07	0.07
Between 295th Street Bridge and Hopkinton Bridge	22433	0.07	0.09	0.06
	21984	0.07	0.1	0.05
Downstream of Hopkinton Bridge	10425	0.07	0.11	-0.06
	10316	0.07	0.12	0.07
	702	0.07	0.11	0.07

VI. Hazard Classification

- Low/Moderate/High
- Impacts Spillway Capacity/Cost of New Project
- A detailed hazard classification analysis was completed and results indicate that a reconstructed Lake Delhi Dam most closely matches the DNR's Moderate Hazard Classification.
- Reviewed by Iowa DNR
- Included in Dam Construction Permit Application

VII. Repair Alternatives Development and Evaluation

- Alternative Development/Evaluation Process
- Project Features With Multiple Alternatives
- Project Features Without Alternatives

Alternative Development/Evaluation Process

- “Brain Storming” session.
 - Establish District Objectives.
 - Review parameters for design development and alternative evaluation.
 - Initiate the creative “brain storming” process for alternative development.

Alternative Development/Evaluation Process (Cont'd)

- District Objectives

- Meet requirements of current dam safety and design standards.
- Minimize operation/maintenance requirements.
- Maintain or improve upstream and downstream flow conditions.
- Provide adequate (50+ year) service life.
- Increase public safety at dam site.
- Improve public recreational opportunities.
- Reduce potential for damage from debris flow.
- Provide cost-effective solution.
- Constructability.
- Minimize right-of-way impacts.
- Minimize permitting requirements.
- Provide opportunity for greater pool control.
- Enhance fisheries opportunities.
- Improve water quality.

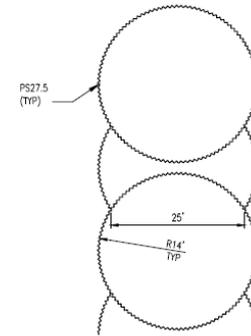
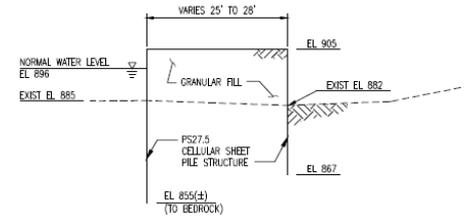
Alternative Development/Evaluation Process (Cont'd)

- Brain-Storm Potential Reconstruction Alternatives
- Review brain-stormed alternatives in terms of Project Objectives and Feasibility of Construction
- Select Alternatives for Continued Development
- Complete Conceptual Design of Selected Alternatives



Project Features With One or More Feasible Alternatives

- North Embankment
 - Double Sheet Pile Wall
 - Cellular Sheet Pile Structure
 - Reinforced Concrete Walls *
- North Downstream Abutment Wall
 - Leave the existing wall as-is
 - Remove and replace the masonry block portion of the wall with large block or mechanically stabilized earth (MSE) wall *
 - Remove and replace the masonry block portion of the wall with a reinforced concrete wall

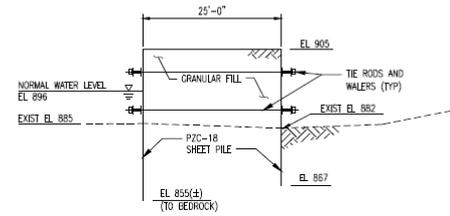
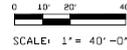


LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES

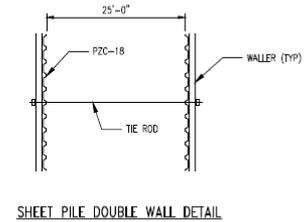
EXHIBIT 2
NORTH EMBANKMENT
CELLULAR SHEET PILE STRUCTURE
PLAN, SECTION, AND DETAIL



PLAN



SECTION B-B



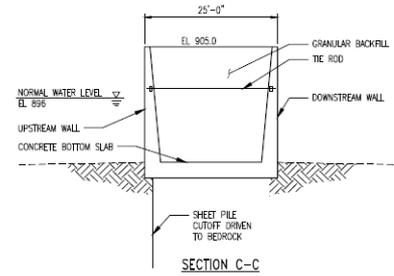
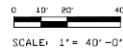
SHEET PILE DOUBLE WALL DETAIL

LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES

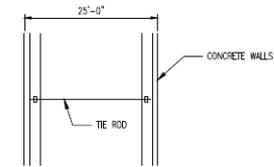
EXHIBIT 3
NORTH EMBANKMENT
SHEET PILE DOUBLE WALL
PLAN, SECTION, AND DETAIL



PLAN

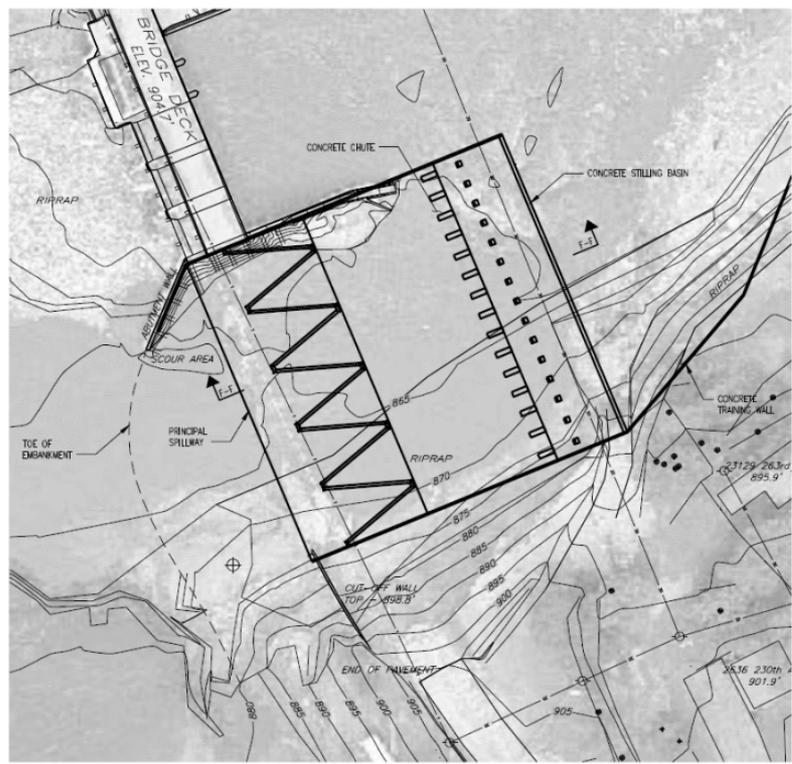


NORTH EMBANKMENT SECTION
REINFORCED CONCRETE WALLS

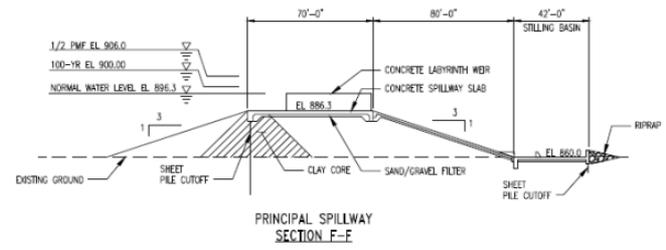


LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES

EXHIBIT 4
NORTH EMBANKMENT
REINFORCED CONCRETE STRUCTURE
PLAN, SECTION, AND DETAIL

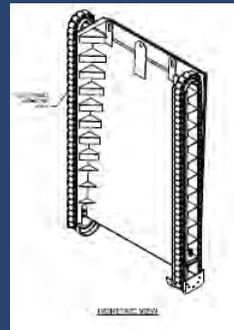


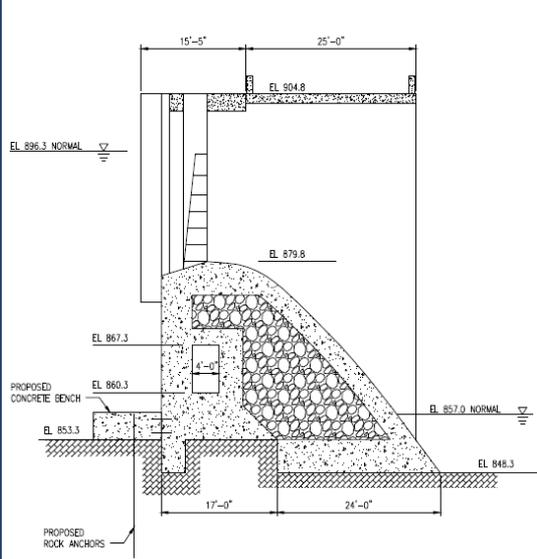
PLAN



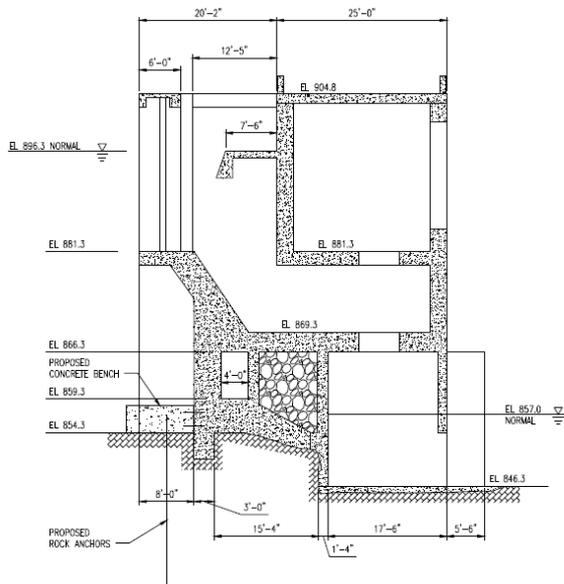
Project Features With One or More Feasible Alternatives (Cont'd)

- Powerhouse/Spillway Stabilization
 - FERC Stability Requirements
 - U.S. Army Corps of Engineers Stability Requirements *
- Powerhouse Bridge Deck
 - Epoxy Seal
 - Waterproof Membrane *
- Spillway Gate Repair/Replacement
 - Radial Gates
 - Crest Gates
 - Lift Gates *

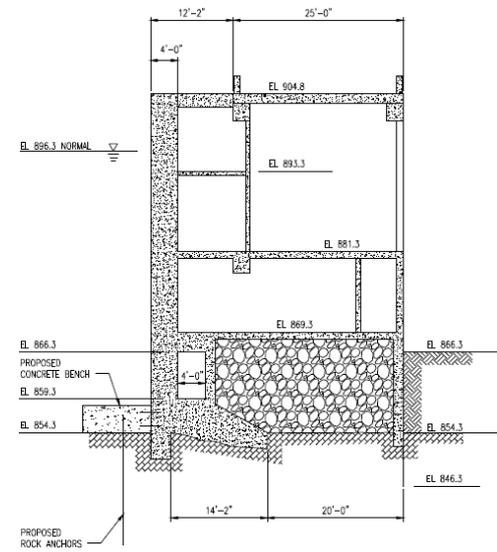




SPILLWAY SECTION



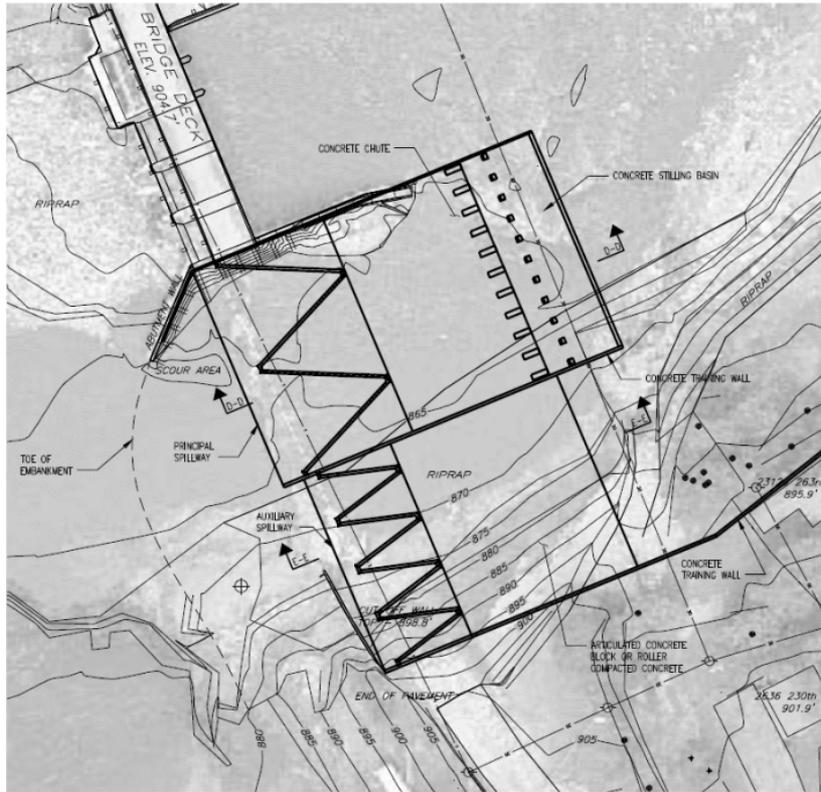
POWERHOUSE SECTION
(TURBINE CENTERLINE)



POWERHOUSE SECTION
(BOILER ROOM CENTERLINE)

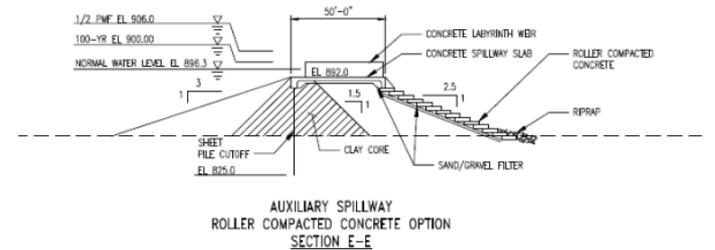
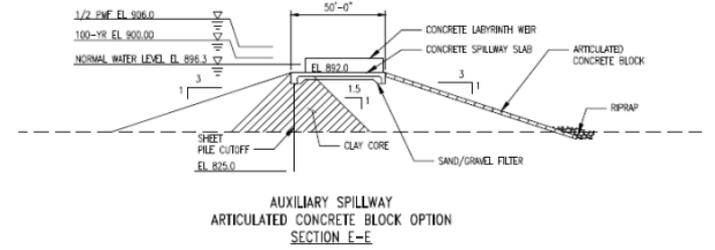
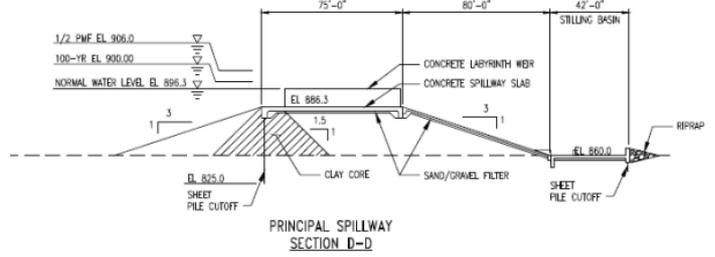
Project Features With One or More Feasible Alternatives (Cont'd)

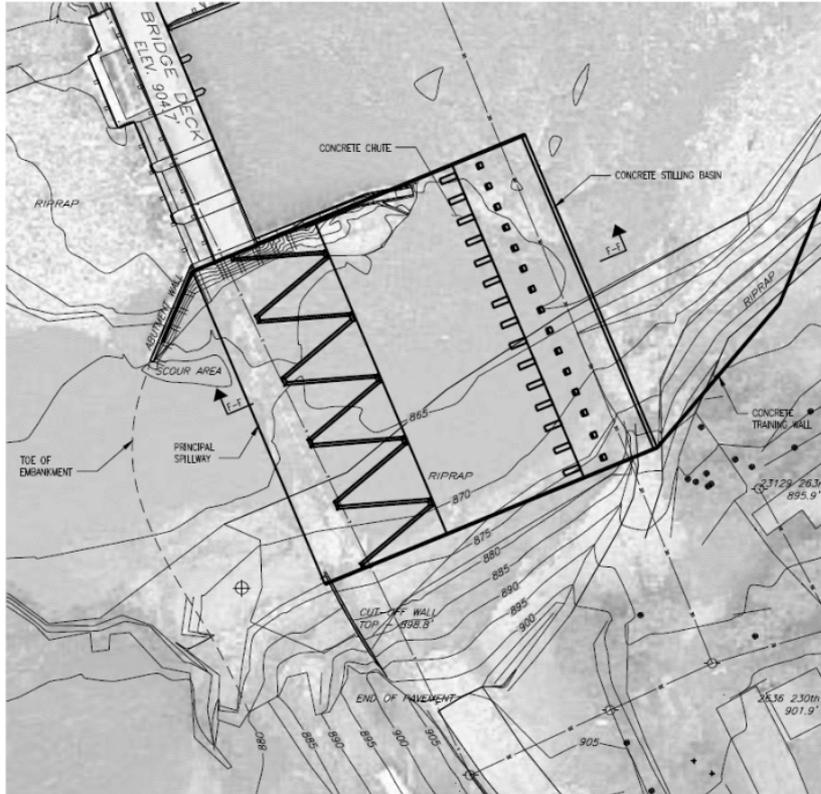
- New Spillway
 - Fuse Plug
 - Add Additional Lift or Radial Gates
 - Conduit Spillway Through Embankment
 - Labyrinth Weir
 - Dual Level
 - Single Level *
 - Pneumatic Crest Gates
- Minimum Flow Passage
 - Refurbish Wicket Gates
 - Install Valves in New Lift Gates *



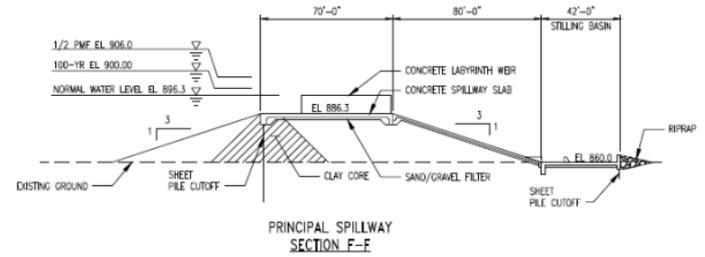
PLAN

0 15' 30' 60'
SCALE: 1" = 60'-0"

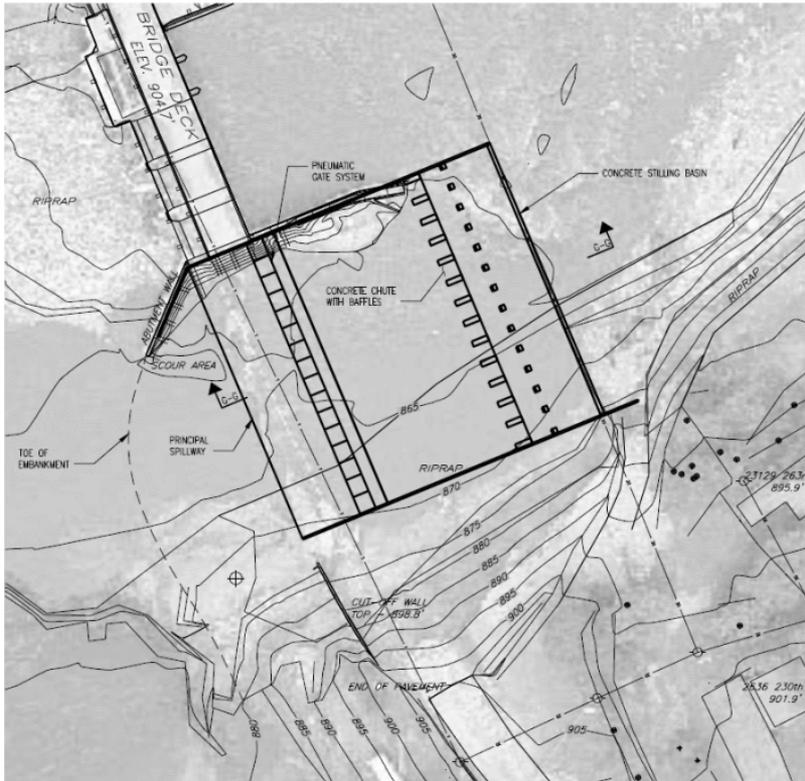




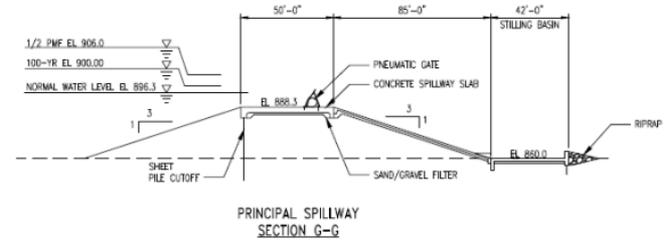
PLAN



PRINCIPAL SPILLWAY
SECTION F-F



PLAN



Project Features With One or More Feasible Alternatives (Cont'd)

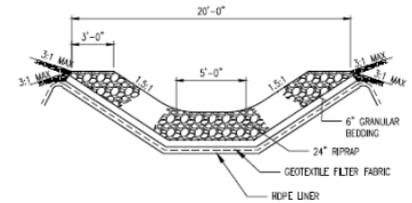
- New South Spillway Embankment Construction
 - Homogeneous Earth
 - Zoned *
 - Roller Compacted Concrete (RCC)
- Existing South Embankment
 - Remove and Replace
 - Improve Existing and Bench Into New *

Option Features

- Fish Passage
 - Recommendation – Not Practical
 - Cost
 - Maintenance
 - Property Impacts
 - Length
 - Invasive Species
 - Dam Safety



PLAN



FISH PASSAGE CHANNEL
SECTION H-H



LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES

EXHIBIT 9
FISH PASSAGE

Option Features (Cont'd)

- Recreational Amenities
 - Handicapped Accessible Fishing Pier.
 - Canoe Portage Trail.
 - Boat Ramp.
 - Observation Deck.
- Sediment Control and Removal
 - Dredging During Construction
 - Sediment Control Features

Non-Alternative/Option Project Features

- Site Access
- Utilities
- Powerhouse/Spillway Concrete Repair
- South Buttress Wall Modification/Repair
- Electrical and Controls
- Safety Features
- Archeological Mitigation
- Property/Easement Acquisition

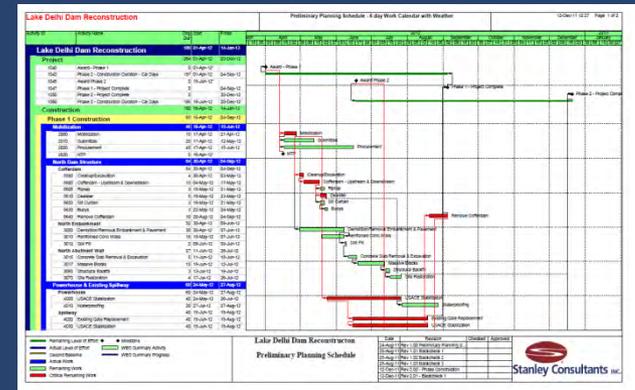


VII. Recommended Project

- Based on the project objective evaluation and cost comparison, reconstruction alternatives were selected for incorporation into the “recommended project.”
- “Recommended Alternatives” were combined with Non-Alternative Features for “Recommended Project”

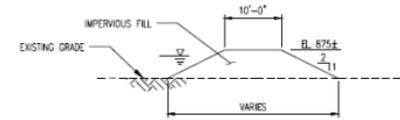
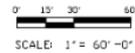
IX. Construction Schedule/Phasing

- Goal – Pool in 2013
- Recommend Two Phase Construction
- Preliminary scheduling - construction could be accomplished in one construction season
 - Assumptions
 - Experienced contractor with sufficient resources
 - Normal weather
 - Normal river flows
 - Normal permitting timeline
 - 6 day work week

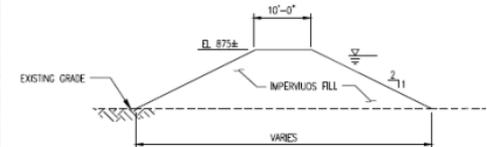




PLAN



**SECTION A-A
PHASE 1 UPSTREAM COFFERDAM**



**SECTION B-B
PHASE 1 DOWNSTREAM COFFERDAM**

NOTES:

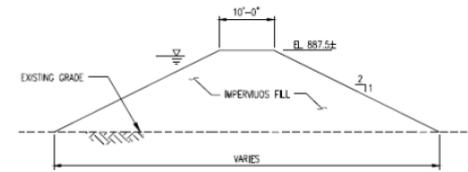
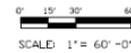
1. OFF-SITE TEMPORARY CONSTRUCTION EASEMENTS MAY BE REQUIRED FOR CONSTRUCTION STAGING/ LAYDOWN AND STOCKPILE AREAS.
2. ARMOR SLOPES AT HIGH SHEAR LOCATIONS AS SHOWN.

**LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES**

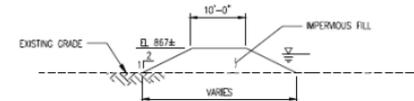
**EXHIBIT 10
CONSTRUCTION STAGING
PHASE 1 COFFERDAM**



PLAN



SECTION A-A
PHASE 2 UPSTREAM COFFERDAM



SECTION B-B
PHASE 2 UPSTREAM COFFERDAM

NOTES:

1. OFF-SITE TEMPORARY CONSTRUCTION EASEMENTS MAY BE REQUIRED FOR CONSTRUCTION STAGING/ LAYDOWN AND STOCKPILE AREAS.
2. ARMOR SLOPES AT HIGH SHEAR LOCATIONS AS SHOWN.

LAKE DELHI DAM
RECONSTRUCTION ALTERNATIVES

EXHIBIT 11
CONSTRUCTION STAGING
PHASE 2 COFFERDAM

X. Construction Cost Estimate

- Combine Costs Estimates for Recommended Alternatives
- Non-Alternative Item Cost Estimates
- Design and Engineering During Construction Costs
- Unit Costs Based on Published Values and Stanley Data Base
- Apply Mark-Ups
 - Undeveloped Design Costs
 - Construction Contingencies
 - Escalation for Inflation
- Recommended Project:
Approximately \$11.9 million

Lake Oahe Dam Reconstruction
Summary of Proposed Costs for Recommended Alternatives
Preliminary Design
Date: 02/15/12

Item No.	Item 1	Item 2	Item 3	Units	Quantity	Unit Cost	Amount	Notes
Construction								
1	Excavation			cu yd	10,000	1.00	10,000	
2	Concrete			cu yd	50,000	1.00	50,000	
3	Rebar			lb	100,000	1.00	100,000	
4	Formwork			sq ft	100,000	1.00	100,000	
5	Foundation			sq ft	100,000	1.00	100,000	
6	Structural Steel			lb	100,000	1.00	100,000	
7	Electrical			sq ft	100,000	1.00	100,000	
8	Plumbing			sq ft	100,000	1.00	100,000	
9	Mechanical			sq ft	100,000	1.00	100,000	
10	Site Work			sq ft	100,000	1.00	100,000	
11	Construction Contingency						10,000	
Design and Engineering								
12	Professional Fees						10,000	
13	Construction Management						10,000	
14	Construction Contingency						10,000	
Subtotal								
							1,190,000	

Lake Oahe Dam - Change Alternative Report 02/15/12 Page 102



XI. Moving Forward

- Present Alternative Report to Agencies
- Initiate Detailed Design and Preparation of Contract Documents
- Permitting and Agency Coordination
- Property/Easement Acquisition
- Identify Qualified Contractors
- Bid Project
- Construction

